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## C-A OPERATIONS PROCEDURES MANUAL

### 2.6.4 Procedure For Lockout/Tagout For The AGS and BOOSTER Rings For Shutdown Periods

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Attachments

#### Hand Processed Changes

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Approved: \_\_\_\_\_ ***Signature on File*** \_\_\_\_\_  
 Collider-Accelerator Department Chairman      Date

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## 2.6.4 Lockout-Tagout Procedure for the AGS and Booster Rings for Shutdown Periods

### 1. Purpose

- 1.1 This procedure provides instructions to Operations Coordinators (OC) and MCR Operators, and Collider-Accelerator (CAS) Technicians to lock out the AGS and/or Booster Accelerator Rings, for Shutdown periods under Restricted Access conditions, allowing personnel to work with the assurance that electrical hazards have been secured or are properly barriered.
- 1.2 C-A Policy states that the preferred method to protect workers from energy sources is Lockout Tagout (LOTO). Alternate means may be employed when the work cannot be performed any other way.

**Caution:**  
This procedure is only to be applied to the AGS and Booster Rings.

- 1.3 Shutdown Periods are defined as those periods when the C-A Main Control Room (MCR) is without a scheduled Operator watch 24 hours a day.

### 2. Responsibilities

#### 2.1 Responsibilities of the Operations Coordinator

- 2.1.1 The OC, the Head of the MCR Group, or the Deputy Accelerator Division Head will inform the MCR Operators or CAS Technicians when to place the accelerator into the Restricted Access state for the Shutdown condition.
- 2.1.2 The OC will designate two MCR Operators or CAS Technicians, one as the Responsible Authorized Person (RAP) and the other as the Safety Watch Verifier (SWV) to perform the LOTO.

If LOTO is in effect during an operator shift change the OC shall:

- designate a new RAP and SWV
- follow the provisions of paragraph 5.1.3. This provision is followed until operators "break shifts".

#### 2.2 Responsibilities of the Maintenance Coordinator

- 2.2.1 The Maintenance Coordinator (MC) shall maintain LOTO during the Shutdown. He shall relinquish LOTO control at the end of the Shutdown to the OC by removing his Lock and Tag which will be replaced by the RAP's Lock and Tag.

- 2.2.2 The MC shall request Systems Specialists to LOTO additional items not on the standard LOTO lists (see [C-A-OPM-ATT 2.6.1.b](#), [2.6.1.d](#), and OPM 2.6.4 attachments as required), to assure safe working conditions if the shutdown conditions require additional LOTO as determined by the MC.

Keys from the locks for the Energy Control Devices of apparatus locked out in addition to the items on the standard checklists, shall be placed in a Lock Box (one lock box for each accelerator), locked, and tagged by the MC. (See paragraph 5.1.4)

- 2.2.3 If LOTO is in effect when there are no operators on duty, the Maintenance Coordinator or his designate shall become the RAP.

### 2.3 Responsibilities of the MCR Operators and CAS Technicians

- 2.3.1 Two MCR Operators or CAS Technicians shall act as the RAP and SWV. They shall perform Group LOTO for the AGS and/or Booster Rings.

### 2.4 Responsibilities of Systems Specialists

- 2.4.1 Systems Specialists are responsible for assisting the RAP in performing the group LOTO according to the Supplementary Checklists when asked by the OC or the MC. The Specialist shall ensure that the lock and tag is applied to the correct energy control device and will act as the Safety Watch Verifier (SWV) for the lockout.

### 2.5 Responsibilities of other workers

- 2.5.1 Personnel, including MCR Operators and CAS Technicians, entering an accelerator ring shall apply their lock, as described in paragraph 5.4.1, to assure their own safety.

## 3. **Prerequisites**

### 3.1 Prerequisites for the OC and the Maintenance Coordinator.

- 3.1.1 LOTO must precede a Health Physics (HP) survey as described in [C-A-OPM 2.6.1](#).
- 3.1.2 To assure electrical safety, the various sources of electrical hazards, range B, C and D as defined in reference 7.1, are appropriately barriered, or shall be opened and locked and tagged out by the RAP and SWV. The list of sources of electrical energy, or electrical apparatus to be opened, locked and tagged, can be found in the attachments referenced in Section 8.0 of this procedure.

3.1.2.1 The following systems have been reviewed and are properly barriered or are in a range A category as defined in reference 7.1:

3.1.2.1.1 Vacuum systems: all vacuum pumps and gauges,

3.1.2.1.2 Ring general services: i.e. 120V, 208V, 480V power receptacles, fire detection and protection equipment, lighting and ventilation equipment.

3.2 Prerequisites for the MCR Operators, or CAS Technicians.

3.2.1 Only qualified and trained MCR Operators or CAS Technicians may perform the LOTO steps outlined in this procedure. Systems Specialists may act as the SWV for the lockout when using the Supplementary Checklists (see C-A-OPM-ATT 2.6.4.a-I).

3.2.2 The Standard Checklists [C-A-OPM-ATT 2.6.1.b](#) and [2.6.1.d](#), are filled out prior to allowing entry into an accelerator.

3.2.3 MCR Operators shall take the lock box key (TOKEN) from the MCR Captured Key Box before leaving the MCR to perform LOTO and shall replace the lock box key (TOKEN) in the MCR Captured Key Box after LOTO is removed.

**Note:**

The Booster and the AGS have their respective TOKENS, TOKEN BOXES, and Lock Boxes.

#### **4. Precautions**

4.1 Precautions for the OC and the Maintenance Coordinator.

4.1.1 All of the items on the RESTRICTED ACCESS LOTO Checklists (see [C-A-OPM-ATT 2.6.1.b](#) and [C-A-OPM-ATT 2.6.1.d](#)), and the Supplementary Checklists, shall be opened, locked and tagged according to this procedure, with the exception of systems designated by the MC.

4.1.2 Additional items may be added to the list of apparatus that is locked and tagged, depending upon the working conditions of the shutdown. The MC shall add the additional items to the "Equivalent" Checklist (see [C-A-OPM-ATT 2.6.1.e](#)).

4.1.2.1 IF [C-A-OPM-ATT 2.6.1.e](#) is used THEN the MC shall delete the "Equivalent Checklist" title and substitute "Supplementary Checklist" for the title, and sign and date the form.

- 4.1.3 The MC shall take the keys to the locks of the Energy Control Devices for the additional apparatus that is locked out (not on the standard LOTO checklists) and place them in a Lock Box (one for each accelerator), and lock and tag each Lock Box.
- 4.1.4 Once the LOTO is in place, the MC is authorized to change the state of the LOTO if he/she follows [C-A-OPM 2.6.8](#).
- 4.1.5 Equipment testing may take place, under Restricted Access conditions, with the approval of the Maintenance Coordinator. See [C-A-OPM 2.6.8](#).
- 4.2 Precautions for MCR Operators, CAS Technicians, and Systems Specialists.
  - 4.2.1 The RAP and SWV shall wear safety glasses when opening energy control devices.
  - 4.2.2 MCR personnel and Systems Specialists that enter an accelerator ring are subject to the requirements of workers as described in paragraphs 2.5 and 5.4 of this procedure.
- 4.3 Precautions for ring entrants.
  - 4.3.1 The matching accelerator ring TOKEN must be in the appropriate accelerator TOKEN BOX, e.g., Booster TOKEN in the BOOSTER TOKEN BOX and the AGS TOKEN in the AGS TOKEN BOX.

The TOKEN BOX will be locked and tagged out by the RAP, the Maintenance Coordinator, or the Head of the MCR Group, or his designate, depending on the status of the Accelerator Complex. The TOKEN will consist of the key from the appropriate accelerator ring Lock Box.
  - 4.3.2 The Temporary LOCK BOX may be used when equipment, not on the standard LOTO checklists, are LOTO. All keys for the energy disconnect switches for this equipment will be placed in the Lock Box, which will be locked and tagged by the MC.

## 5. **Procedure**

### 5.1 Procedures for the OC and MC.

#### 5.1.1 **RESTRICTED ACCESS**

- a. With the accelerator on Access Prohibited, the OC shall instruct the CAS or Operators to perform LOTO using the Standard (Restricted Access) Checklists ([C-A-OPM-ATT 2.6.1.b](#) and [ATT 2.6.1.d](#)) and the instructions outlined in paragraph 5.2 below.

- b. When LOTO using the standard checklist is completed, and an HP survey completed (where required), the accelerator may be switched to the Restricted Access state.
- c. The MC or OC shall instruct Systems Specialists to report to the OC to assist the RAP in LOTO for the items listed in the Supplementary Checklist ([C-A-OPM-ATT 2.6.4.a](#) through [C-A-OPM-ATT 2.6.4.i](#)).

#### 5.1.2 CHECKLISTS

- a. Standard Checklist, ([C-A-OPM-ATT 2.6.1.b](#) and [2.6.1.d](#)) is a list of energy sources, approved by the Department Chief Electrical Engineer, which when opened, locked, and tagged, will produce a condition of minimal electrical hazard in the ring enclosure in the Restricted Access state.
- b. Equivalent Checklist, ([C-A-OPM-ATT 2.6.1.e](#)) provides the same level of safety as the Standard Checklist, and does not need to be approved by the Chief Electrical Engineer. The OC, with the help of the Systems Specialist, can determine whether a lockout is equivalent. It may be employed when authorized by the Assistant Division Head, the Head of the MCR Group, the Chief Electrical Engineer, or the Maintenance Coordinator.

This checklist is used in conjunction with the Standard Checklist and it lists items which are locked out instead of the items on the standard list, or the devices whose circuits, entering the ring, have been disconnected, locked and tagged.

- c. Supplementary Checklist is a list of devices not normally locked out by operators when the rings are in Restricted Access, but which are locked out during shutdowns.

#### 5.1.3 INSTRUCTING OPERATORS

- a. During normal operations, the OC shall designate a RAP and SWV to perform the lockout.

During non-operating periods the RAP and SWV may be designated by the Head of the MCR Group or the Maintenance Coordinator.

The MC shall replace the RAP LOTO with his own LOTO when the Lockout/Tagout is complete, and the operators will no longer be on shift.

#### 5.1.4 LOCK BOX

5.1.4.1 As the shutdown evolves, additional apparatus (eg. parts of the vacuum system) may need to be de-energized, locked and tagged. The MC shall list this equipment on the "Equivalent Checklist" (see [C-A-OPM-ATT 2.6.1.e](#)), after editing the title of the form, and signing and dating the form.

5.1.4.2 The MC shall take the keys to the locks for the Energy Control Devices for the additional apparatus and place them in a Lock Box (one for each accelerator).

5.1.4.3 The MC shall instruct the Systems Specialist to erect a "safety zone" consisting of a tape barrier (where appropriate) around the affected equipment.

5.1.4.4 As work is completed in these temporary safety zones, the MC shall return the keys to the locks for the Energy Control Devices (from the Temporary Lock Box) after workers remove their locks. The MC shall then instruct the Systems Specialists to remove the barriers and re-energize the affected apparatus.

#### 5.2 Procedures for MCR Operators, CAS Technicians and Systems Specialists to perform LOTO.

5.2.1 The RAP and the SWV shall prepare, or use previously prepared Red Tags and record same in the MCR LOTO Logbook. The MCR LOTO Logbook will consist of a bound volume where each side of a page will have stapled to it one page of the check list in use.

5.2.2 The RAP and SWV shall lockout and tagout the appropriate energy control devices for the accelerator rings using the checklist(s) designated by the OC. The RAP and SWV shall enter the appropriate information on the checklist as each energy control device on the checklist is opened, locked, and tagged. The RAP shall note, on the back of the checklist, any special instructions or hazards.

5.2.3 The RAP shall turn each switch to the open/off position, then open the door of the switch to visually check that all poles of the switch have opened. The SWV or Systems Specialist shall confirm that the proper switch has been operated and that the poles are open.

**Caution:**

Under NO circumstances shall components or wiring inside the switch be touched since they may be energized.

- 5.2.4 If the switch blades are not visible, the RAP shall check if there are fuses installed in the switch. Even if there are none, the RAP shall test the load/output terminals for voltage with a "Wiggins" voltage meter (see paragraph 5.2.5).
- 5.2.5 If the fuses are installed, the RAP shall use a Wiggins or "Wiggy" voltage meter to determine if the switch is open by checking the voltage on the load side of the fuses. All line-to-line voltages (A-B, B-C, C-A) and/or all line-to-ground voltages shall be zero for the switch to be considered open.
- 5.2.6 The RAP shall then close the door and apply the lock and tag to the switch handle. The lock number shall be entered on the checklist and both the RAP and the SWV shall initial the entry in the column marked RAPon and SWVon respectively. RAP shall then sign and date the laminated LOTO Tag.

**Note:**

Instead of using a Wiggins to measure Voltage, Operators may verify that apparatus is de-energized by attempting to turn on the power supply locally.

- 5.2.7 When using the Supplementary Checklist(see [C-A-OPM-ATT 2.6.4.a](#)–[C-A-OPM-ATT 2.6.4.i](#)), the RAP and the Systems Specialist shall initial in the appropriate column.
- 5.2.8 Tokens
- a. After all switches for the AGS have been locked and tagged open, the RAP shall place the set of keys into the AGS Lock Box located in the MCR and a lock shall be applied to this box. The key to this lock now becomes the AGS TOKEN.
  - b. After all switches for the Booster have been locked and tagged open, the RAP shall place the set of keys into the Booster lock box located in building 914, and a lock shall be applied to this box. The key to this lock now becomes the BOOSTER TOKEN.

5.2.9 The RAP shall place each TOKEN in the appropriate TOKEN BOX, and lock and tag the TOKEN BOX, using a lock multiplier.

5.2.9.1 The AGS TOKEN BOX is located at the AGS Ring South Gate. The BOOSTER TOKEN BOX is located in building 914 next to the "Mangate".

5.2.10 The RAP shall affix the checklists (one to each side of the page) in the MCR LOTO Logbook.

The RAP shall store the key(s) to the TOKEN boxes in the MCR Captured Key Box.

The RAP shall transfer the LOTO to the MC by removing his lock and tag from the TOKEN Boxes at the same time as the MC applies his lock and tag to the TOKEN BOXES.

5.3 Procedures for MCR Operators and Systems Specialists to remove LOTO after Shutdown is completed.

5.3.1 The Maintenance Coordinator shall arrange to have all personnel remove their locks from the TOKEN BOXES and Temporary Lock Boxes, and shall ensure all tape barriers, that delineated safety zones, have been removed.

The MC shall accompany the designated RAP to the TOKEN BOX to transfer the LOTO to the RAP.

5.3.2 When in Restricted Access, the OC shall have the accelerator placed into the Controlled Access state and the enclosure will be swept free of personnel.

5.3.3 The RAP shall open the appropriate TOKEN BOX and then use the TOKEN to open the appropriate Lock Box.

5.3.4 Using the keys from the Lock Box, the RAP and SWV or the Systems Specialist shall unlock and re-close the required energy control devices and make the apparatus ready for operations.

5.3.5 The RAP and SWV, or the Systems Specialist shall use the same checklist(s) that was used to install the LOTO, and initial RAPoff and SWVoff columns as each item is unlocked and re-closed. The RAP shall note any special instructions or hazards written on the back of the checklist.

5.3.6 The RAP shall return all red tags to the MCR and place the TOKEN(S) in the MCR Captured Key Box.

5.4 Procedure followed by all personnel entering an accelerator ring enclosure.

- 5.4.1 Personnel entering an accelerator ring enclosure to work shall confirm that the TOKEN BOX contains the TOKEN, and that it is locked and tagged out. They shall then apply their lock to the lock multiplier on the TOKEN BOX at the AGS South Gate before entering the AGS for the first time during the Shutdown. They shall apply their lock to the key multiplier on the TOKEN BOX at the Booster Mangate before entering the Booster for the first time during the shutdown.
- 5.4.2 Personnel shall respond to requests from the MCR to remove locks from lock multipliers on TOKEN BOXES. The MCR shall make use of the AGS CATV system, or the public address system, in order to make their requests known.
- 5.4.3 If entry to both accelerator rings is required during the same period, then personnel shall apply a separate lock to each TOKEN BOX.
- 5.4.4 Workers shall remove their locks and tags from the TOKEN BOX at the conclusion of the maintenance task.
- 5.4.5 For long Shutdown periods workers may leave their locks and tag (as required by [BNL ES&H Standard 1.5.1](#)) on the TOKEN BOX, unless asked to remove them by the Maintenance Coordinator.
- 5.4.6 Workers shall apply their locks to the Temporary LOCK BOXES when working on a specific system, or as requested by the Maintenance Coordinator.

**6. Documentation**

- 6.1 MCR LOTO Logbook
- 6.2 Appropriate Checklist from [C-A-OPM-ATT 2.6.1.b](#), [C-A-OPM-ATT 2.6.1.d](#), [C-A-OPM-ATT 2.6.4.a](#) – [C-A-OPM-ATT 2.6.4.i](#).

**7. References**

- 7.1 BNL ES&H Standard section [1.5.0](#), and [1.5.1](#)
- 7.2 AGS Lockout Tagout Training -- course 15.17.00.02

- 7.3 [C-A-OPM 2.6.1, " Procedure for Lockout/Tagout for the AGS and Booster Rings, During Accelerator Operations".](#)
- 7.4 [C-A-OPM 2.6.8, Procedure for Controlling Access to the AGS/ Booster Enclosures for Systems Testing During Shutdown Periods](#)

## **8. Attachments**

- 8.1 [C-A-OPM-ATT 2.6.4.a, "AGS Ring Lockout-Tagout Supplementary Checklist Restricted Access; EAG Group".](#)
- 8.2 [C-A-OPM-ATT 2.6.4.b, "AGS Ring Lockout-Tagout Supplementary Checklist Restricted Access; Security Group".](#)
- 8.3 [C-A-OPM-ATT 2.6.4.c, "AGS Ring Lockout-Tagout Supplementary Checklist Restricted Access; Instrumentation Group".](#)
- 8.4 [C-A-OPM-ATT 2.6.4.d, "AGS Ring Lockout-Tagout Supplementary Checklist Restricted Access; Vacuum Group".](#)
- 8.5 [C-A-OPM-ATT 2.6.4.e, "AGS Ring Lockout-Tagout Supplementary Checklist Restricted Access; Beam Components Group ".](#)
- 8.6 [C-A-OPM-ATT 2.6.4.f, "AGS Ring Lockout-Tagout Supplementary Checklist Restricted Access; RF Group".](#)
- 8.7 [C-A-OPM-ATT 2.6.4.g, "AGS Ring Lockout-Tagout Supplementary Checklist Restricted Access; Power Supply Group".](#)
- 8.8 [C-A-OPM-ATT 2.6.4.h, "AGS Ring Lockout-Tagout Supplementary Checklist Restricted Access; Operations Support Group".](#)
- 8.9 [C-A-OPM-ATT 2.6.4.i, "AGS Ring Lockout-Tagout Supplementary Checklist Restricted Access; EAG Group".](#)
- 8.10 [C-A-OPM-ATT 2.6.4.j, “ AGS Ring Lockout-Tagout Supplementary Checklist Restricted Access; ATR.](#)